

Nicht-perturbative QCD Effekte und Messungen der Top Masse

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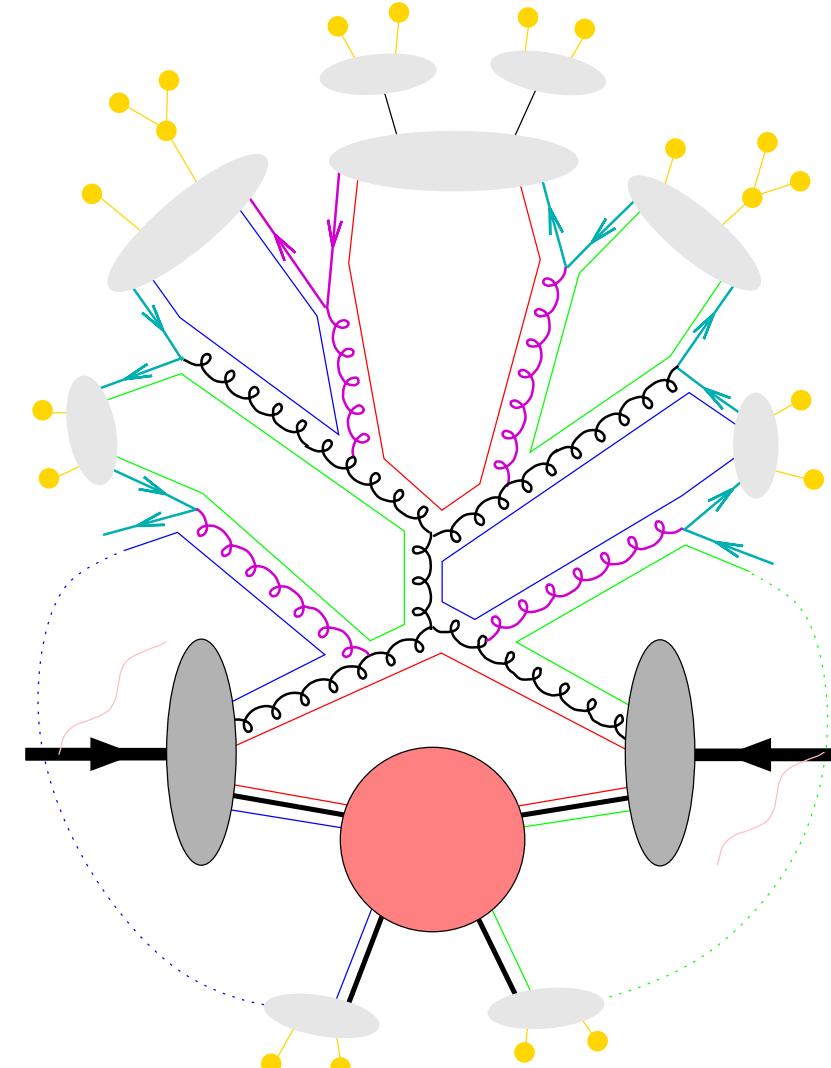
Outline

- Einführung
- CR Modelle in Hadronkollisionen
- Einfluss auf Messungen der Top Masse

Introduction

Modelling

- PDFs
- ISR
- Hard Process
 $2 \rightarrow 2(3)$, $2 \rightarrow \text{many}$; LO, NLO
- Scales
- Parton Shower
various PS; matched or unmatched
- Colour reconnection (CR)
- Hadronisation
- Decays
- Underlying Event (UE)



Some steps not computed from first principles \Rightarrow Modelling required

CR Models

Existing pythia tunes

Several pythia tunes to min. bias data (by R. Field) available

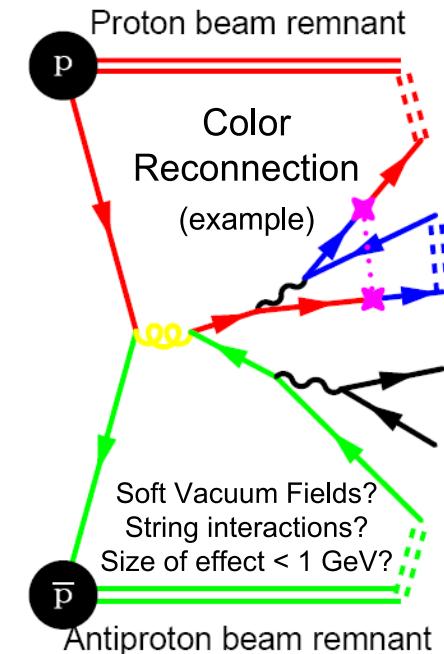
Tune A, Tune DW, Tune BW.

These implicitly allow CR within UE interaction to a high level.

New CR Models: Colour Annealing

Allow CR also within the hard interaction.

- Strings may reconnect with some probability.
- New connection chosen to minimise string length.
- Model variations: $S0$, $S1$, $S2$
differ in suppression of gluon only string loops



Tuning the Models

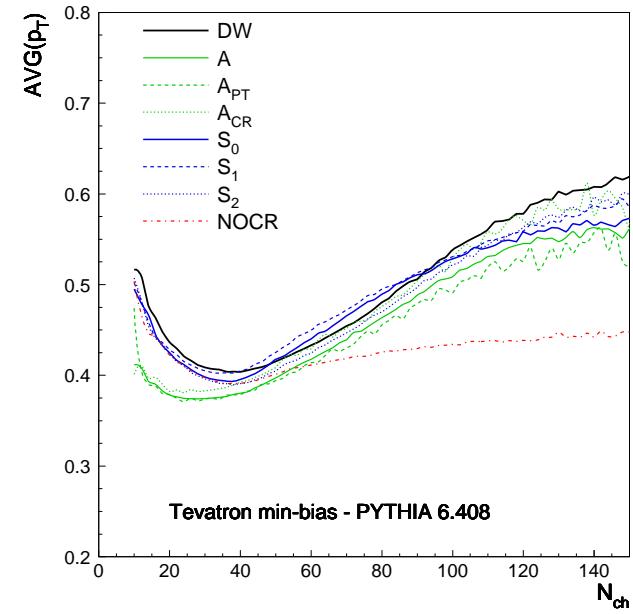
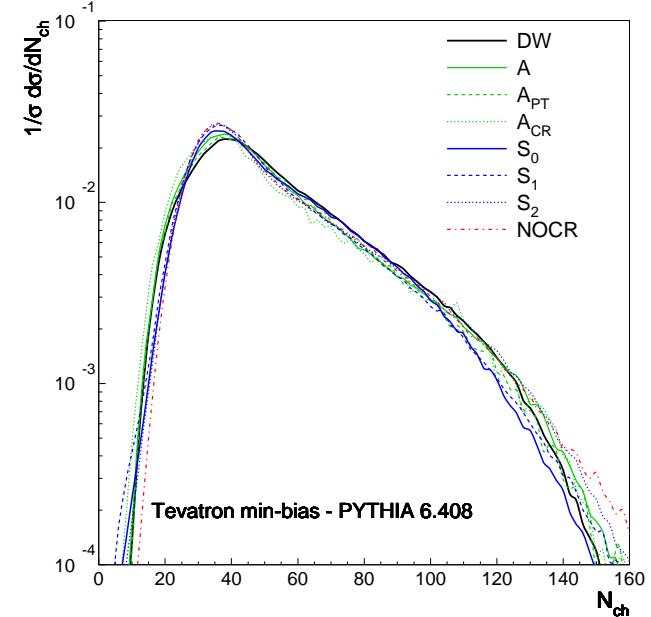
CR used in UE description \Rightarrow retune both.

Tune A is known to describe data reasonably well.

Thus models tuned to it.

- New CR models were tuned to describe N_{ch} and $\langle p_T \rangle(N_{ch})$.
- Right: comparison of models.
(Red is no CR, tuned)
- NoCR can't be made to agree:
CR seems necessary to describe UE features.

New Models w/ tunes available in Pythia 6.408+.

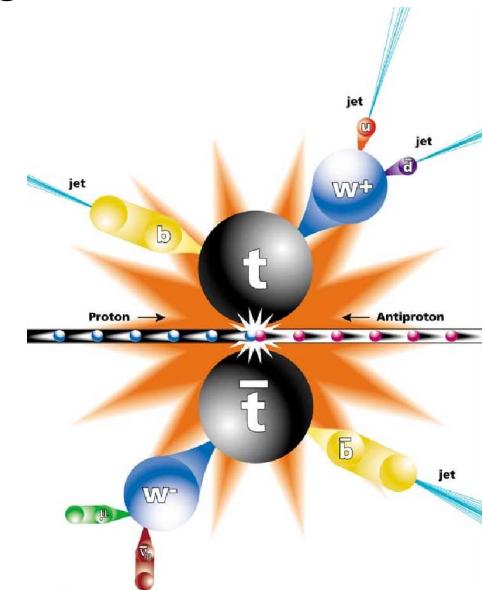


Top Mass Measurement

Features of Real Mass Measurements

Current real life mass measurements contain 3 important ingredients.

- Mass estimator
 - Reconstructed physics objects
 - Jet assignment (choose or weight)
- Overall JES correction factor
- Calibration of method
 - Uses Simulation \Rightarrow may be affected by changes in CR models.



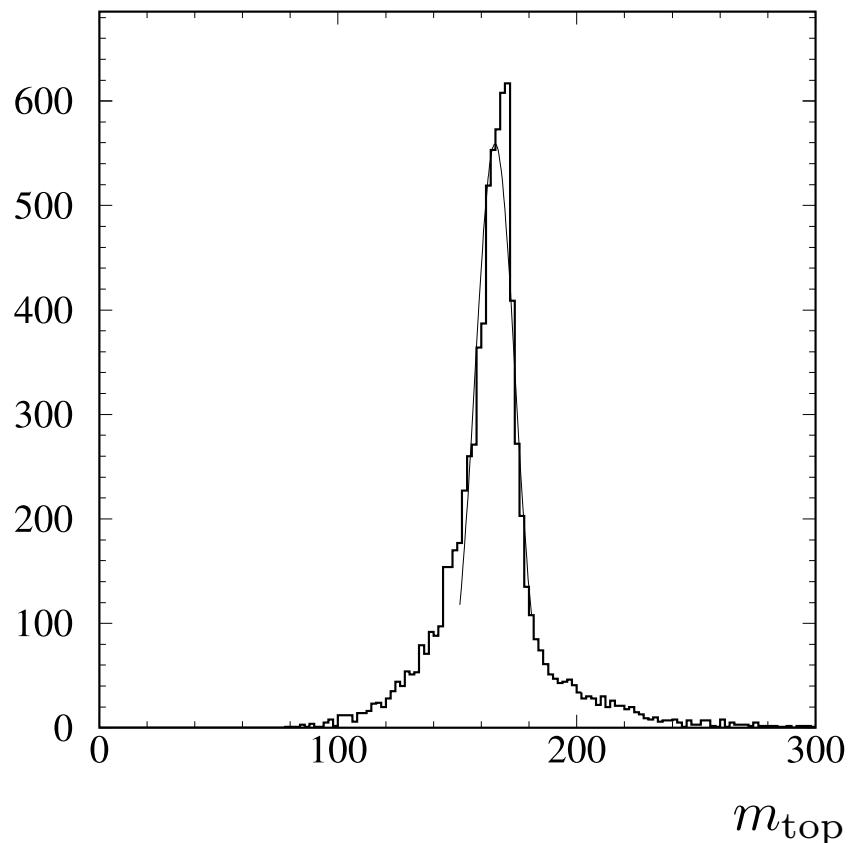
To concentrate on physics effects (and avoid dealing with detector simulation)
a simplified toy mass measurement is implemented.

Toy Mass Estimator

- For each available model 100k inclusive events were generated
- Jets are reconstructed using Cone ($\Delta R = 0.5$, $p_T > 15 \text{ GeV}$)
- Exactly 4 reconstructed Jets
- Technical simplifications:
 - Generator semileptonic events.
 - Unique assignment to MC truth by ΔR possible.
- Reconstruct mass on correct assignment only: $m^2 = (p_{b\text{jet}} + p_{q\text{jet}} + p_{q'\text{jet}})^2$
(using hadronic side)

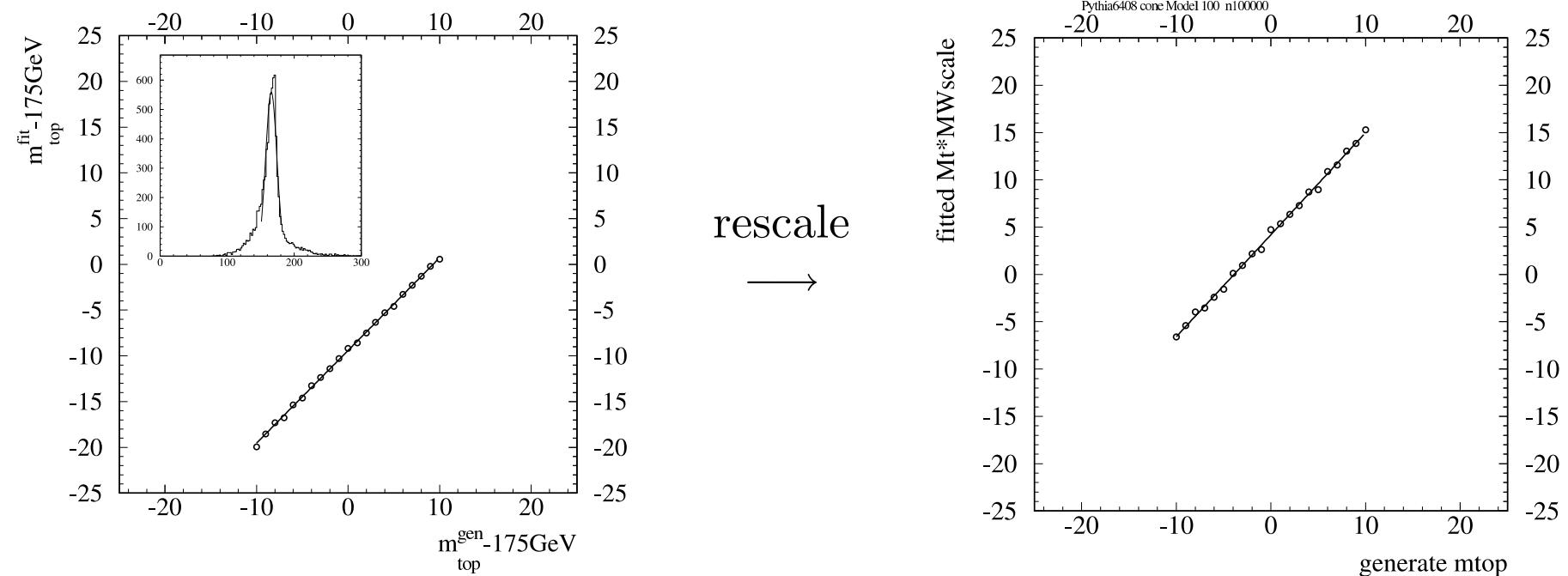
Mass Distribution

- Reconstruct mass on each event.
- Fit distribution with Gaussian: $m_{\text{top}}^{\text{fit}}$.
 - Fitrange: $\pm 15 \text{ GeV}$ (iterated to avoid bias).
 - Varied fit ranges in syst. studies.
 - Suffers from out of cone problems.
- Rescale using M_W
 - Analog to JES fitting
 - Fit W -mass from light jets
 - Scale with $s_{\text{JES}} = 80.4 \text{ GeV}/m_W$: $m_{\text{top}}^{\text{scaled}} = s_{\text{JES}} m_{\text{top}}^{\text{fit}}$



This provides two mass estimators: $m_{\text{top}}^{\text{fit}}$, $m_{\text{top}}^{\text{scaled}}$

Calibration Curves



- Calibration curves show reasonably linear behaviour
- Scaling with m_W does the right thing (offset significantly reduced)
- Fit straight line to obtain offset at 175 GeV

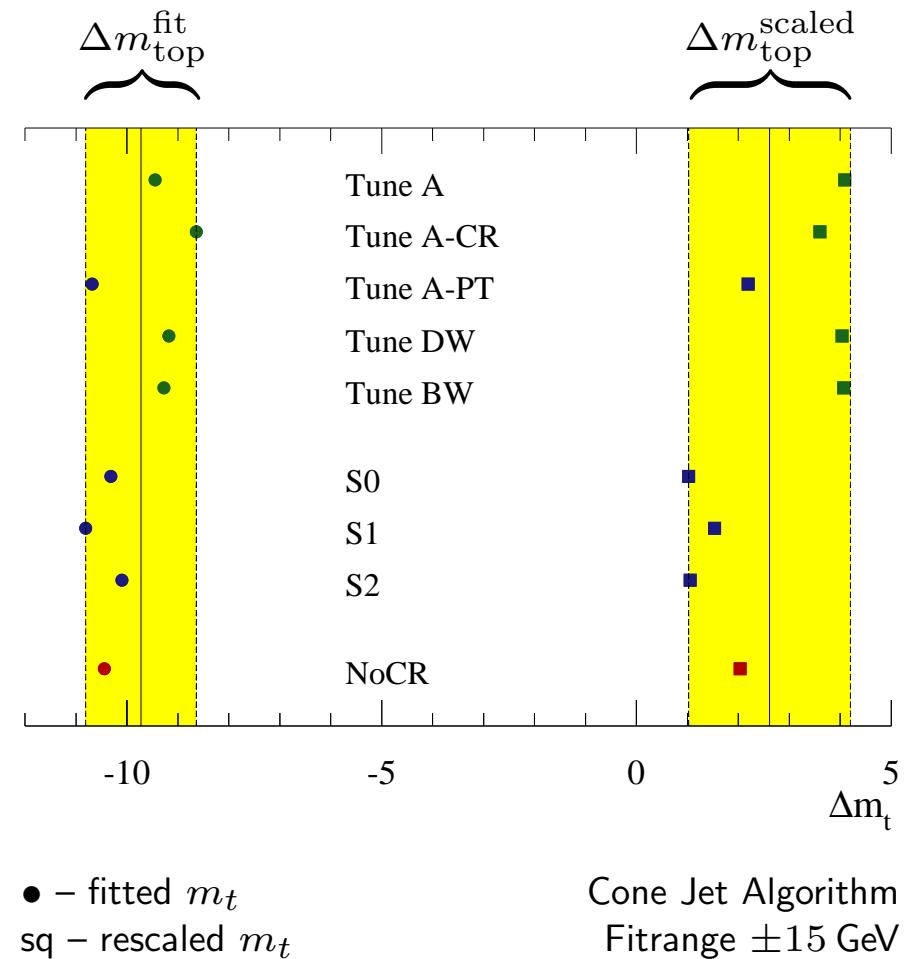
Procedure has been repeated for a various (tuned) models **to compare offsets**

Calibration uncertainty

- Offsets and slopes from normally used to correct measurement methods

- Model dependence is m_t uncertainty

- Spread of ± 1.5 GeV observed



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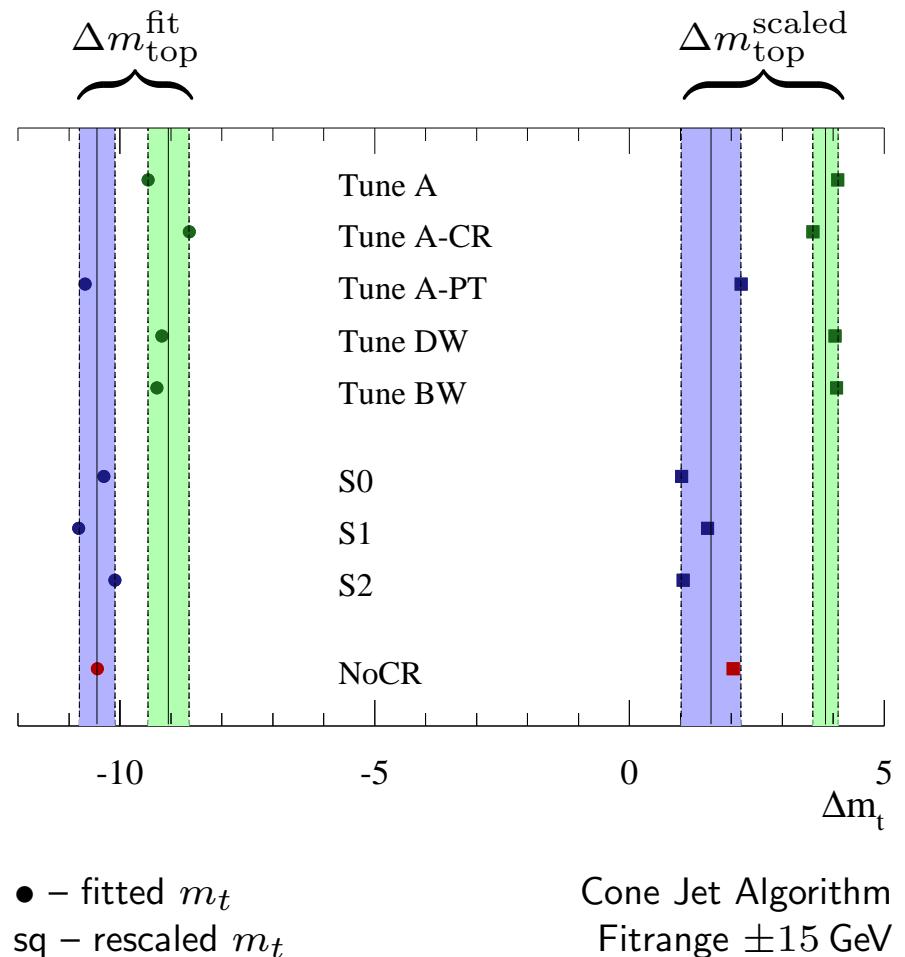
- Spread of ± 1.5 GeV observed

- 2 model classes with similar offsets

- Virtuality ordered (old) Parton Sh.
 - P_T ordered (new) Parton Shower

Significant diff. of perturbative origin

- Within each group ~ 0.5 GeV of non-perturbative nature remain.



Summary

- Investigated new Colour Reconnection Models for Hadron Collisions.
 - Colour reconnections seem necessary to describe underlying events.
 - UE models require retuning for different CR models.
 - Retuning performed on a variety of models.
- Studied influence of CR models on (toy) m_{top} measurements
 - Model dependence comparable to currently quoted syst. uncertainties.
 - Separable into 1 GeV perturbative and 0.5 GeV non-perturbative portion.
 - Only partly considered in current measurements.
- Sensitivity of real life top mass measurements may vary.
 - Needs investigation with full detector simulation.
 - Collaboration with CDF and DØ teams needed and planned.

hep-ph/0703081